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ASTROPHYSICS.—*Concerning the origin of chemical elements.*[1] G. GAMOW, The George Washington University.

It is well known that the chemical analysis of the universe indicates a striking uniformity in the distribution of various chemical elements. In fact, we know that the meteorites, which most probably represent the fragments of some old broken-up planet, possess nearly the same proportions of various elements as the samples of terrestrial material, and that the spectral analysis of our sun and other stars leads again to a very similar chemical constitution.[2] It may be added that the recent investigations of interstellar absorptions indicate that approximately the same chemical constitution should be also ascribed to the extremely rarified gaseous material filling up the interstellar space.

Considering the known abundances of various elements from the point of view of possible nuclear transmutations, we should ask ourselves first of all whether these abundances are due to some nuclear processes taking place *at present* in various parts of the universe, or whether the abundance-curve should be considered as a "frozen-distribution" corresponding to some unusual conditions that existed in the *early creative stage* of the universe? The recent study of the problem of stellar energy sources shows quite definitely that *some features* of the abundance-curve are of more or less contemporary origin and can be understood on the basis of thermonuclear reactions taking place in the hot interior of stars. Thus, for example, we know that light elements lithium, beryllium, and boron are subject to rather rapid destructive reactions in the presence of hydrogen at the temperatures ranging from 5 to 15 million degrees. These thermonuclear reactions proceed according to the equations:

$$^{6}\mathrm{Li} + {}^{1}\mathrm{H} \rightarrow {}^{4}\mathrm{He} + {}^{3}\mathrm{He}$$
$$^{7}\mathrm{Li} + {}^{1}\mathrm{H} \rightarrow 2\,{}^{4}\mathrm{He}$$
$$^{9}\mathrm{Be} + {}^{1}\mathrm{H} \rightarrow {}^{6}\mathrm{Li} + {}^{4}\mathrm{He}$$
$$^{10}\mathrm{B} + {}^{1}\mathrm{H} \rightarrow {}^{11}\mathrm{C} + h\nu$$
$$^{11}\mathrm{B} + {}^{1}\mathrm{H} \rightarrow 3\,{}^{4}\mathrm{He}$$

and result in the complete destruction of the elements in question and the formation of the large amounts of thermonuclearly inert helium. It was suggested by Gamow and Teller[3] that these particular reactions represent the main source of energy in the early stages of stellar evolution (in the so-called red-giant-stars), and that entering the main sequence the star must have these three elements completely destroyed in its interior regions. Although in the outer layers of the star the temperature is not high enough to induce such reactions, a certain amount of these elements must have been removed by diffusion from the stellar atmospheres, a fact that explains the anomalous drop in the corresponding region of the abundance-curve. In the next, main-sequence stage of stellar evolution the tem-

[1] Received October 26, 1942.

[2] The only large discrepancy between the chemical constitution of stellar and of terrestrial material consists in comparatively large abundance of hydrogen and helium in stars (35 per cent H and at least a few percent of He) as compared with the earth (0.001 percent of H, and 0.000,000,000,1 percent of He). There is, however, no doubt that this large discrepancy in abundances is of purely secondary character and is entirely due to the fact that H and He, being the light gases, had much better chance to escape from the terrestrial atmosphere into the surrounding empty space.

[3] G. GAMOW and E. TELLER. Phys. Rev. 55: 791. 1939.

perature in the interior rises up to 20 million degress, inducing thermonuclear reactions of the next two elements, carbon and nitrogen, which, according to Bethe,[4] undergo the following transformations:

$$^{12}C + {}^{1}H \rightarrow {}^{13}N + h\nu$$
$$^{13}N \rightarrow {}^{13}C + e^{+}$$
$$^{13}C + {}^{1}H \rightarrow {}^{14}N + h\nu$$
$$^{14}N + {}^{1}H \rightarrow {}^{15}O + h\nu$$
$$^{15}O \rightarrow {}^{15}N + e^{+}$$
$$^{15}N + {}^{1}H \rightarrow {}^{12}C + {}^{4}He$$

We see from these formulae that carbon and nitrogen are not being completely destroyed by the reaction, but are constantly regenerated, thus serving only as some kind of catalysis for the transmutation of hydrogen into helium. The above reactions, however, serve to establish a definite balance between the relative abundances of $^{12}C - {}^{13}C$ and $^{14}N - {}^{15}N$ isotopes. For the temperature and pressure existing in stellar interiors, the equilibrium-proportions of these isotopes have been calculated by Bethe to be 70:1 and 500:1, which is in fair agreement with the observed abundances.

In spite of these successes in understanding the features of the abundance-curve for lightest elements, however, the situation becomes much more difficult in the case of heavier elements. In fact, there seems to be no doubt that the much higher temperatures, needed for the transmutation of heavier elements, are not to be found in stellar interiors or, for that matter, in any other part of the present state of the universe.[5] Thus the only possible way to understand the origin of heavy, and particularly of radioactive elements lies in the assumption that in some previous stage of the development of our universe, physical conditions have been in general entirely different from what they are now, and that the temperature and density of matter then were, as a rule, much higher. Such a hypothesis finds strong support in the theory of expanding universe, according to which the matter, which is at present distributed rather rarely through space, expanded from the original state of very high density and temperature. It is particularly interesting that, according to the measured rate of present expansion, these extraordinary physical conditions in space must have been existing only about 2 or 3 billion years ago, a period of time comparable with the life-period of the long-living radioactive elements (thorium and uranium), which are still in existence.

Considering the present abundance of elements as the result of these long-past conditions, one can follow two different points of view: (1) That the abundance-curve corresponds to a thermodynamic equilibrium state at some very high density and temperature, which existed during a certain early expansion-stage of the universe; and (2) that relative abundances of various elements are due to a non-equilibrium breaking-up process of the original bulk of nuclear matter caused by a rapid expansion in the early evolutionary stages.

A detailed study of the first possibility was carried out recently by Chandrasekhar and Henrich,[6] who calculated the equilibrium-numbers of various nuclei corresponding to conditions of extremely high densities and temperatures. In these calculations, which extended over the first 20 elements of the periodic system, the authors took into account the exact values of the mass-defects of the nuclei in question with the interesting result that the theoretical abundance-curve repeats rather exactly all local irregularities of the empirical curve. It must be noticed, however, that this particular result does not necessarily speak in favor of the thermodynamic-equilibrium hypothesis, since also in the case of a rapid breaking-up process more stable nuclei should have been produced in larger quantities than the less stables ones.

In respect to the general behavior of the abundance-curve, the results are considerably less satisfactory, which is owing exclusively to a very peculiar behavior of the

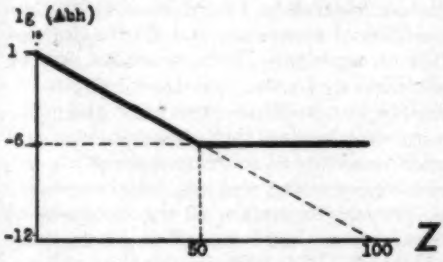
[4] H. BETTHE. Phys. Rev. 55: 434. 1939.

[5] An attempt to understand the building-up (Aufbau) process of heavy elements at the comparatively low temperatures existing in stars was made by Weizsäker (Phys. Zeitschr. 39: 633. 1938), but it turned out to be completely unsuccessful and has been entirely abandoned.

[6] S. CHANDRASEKHAR and L. R. HENRICH. Astr. Journ. 9: 288. 1942.

empirical curve. In fact, the general habitus of this curve can be characterized as *a rapid exponential decrease up to the middle of the periodic system, and an approximate constancy in the second half of it.* (See figure.)

This character of the exponential curve excludes any possibility of understanding the abundance of all elements as the result of some kind of equilibrium, since in choosing the temperature and density so as to fit the decreasing half of the curve (Chandrasekhar and Henrich assume $\rho = 10^7 \text{gm/cm}^3$ and $\tau = 8.10^8\,^\circ\text{C}$), one should necessarily expect the continuation of such decrease also for the group of heavier elements. There also seems to be no physical possibility of



explaining the peculiarity of the empirical curve by any kind of "freezing up" of heavier elements while the lighter ones are still being transformed. In fact, any such transformation should be necessarily connected with the emission of a large number of high-energy neutrons, which are bound to affect the relative number of heavier elements, and to cause the later part of the curve to drop down.

We can try now to investigate the second possibility, and to see which kind of distribution could be obtained from the hypothesis of a rapid breaking up of the original superdense nuclear matter. We must remember that, according to our present knowledge of nuclear fission-processes, all nuclei that are heavier than uranium would be immediately broken into two or more approximately equal parts (slight deviation from equality of fission-fragments being due to the irregular character of the mass-defect curve). If we assume for a moment that each unstable superheavy nucleus breaks up in only two approximately equal parts, the statistical result of such a breaking up process, will evidently correspond to *an equal abundance of all elements belonging to the second half of the periodic system, and to a complete absence of all lighter elements.*

This gloomy picture may be improved, however, if we remember that: (1) Even in ordinary uranium-fission *a number of free neutrons are being emitted in each breaking-up process, and this number most probably increases in the case of the more violent fission of superheavy nuclei.* Neutrons produced this way will turn spontaneously into protons, and will contribute to a larger abundance of hydrogen. (2) Although (in the known fission-processes of radioactive elements), the nucleus always breaks in only two fragments, *we may expect that for the heavier nuclei the probability of triple and higher order splitting is considerably larger.* Such multiple splitting of nuclei several times heavier than uranium will not much affect the equipartition in the second half of the periodic system, but will, on the other hand, produce a large number of lighter nuclei.

It seems, therefore, on the basis of the foregoing remarks, that this possibility is not entirely excluded, that the main features of the abundance curve may be explained as the result of a complicated fission-process. In order to answer this question in a more definite way it will be necessary to study the stability of superheavy nuclei with respect to multiple-fission and to investigate the statistical distribution of the fission-fragments in a successive breaking down process. The work in this direction is now in progress, and its results (if any) will be published later.

PHYSICS.—*Physical explanation and the domain of physical experience.*[1] R. B. LINDSAY, Brown University. (Communicated by R. J. Seeger.)

The prevalent interest of philosophers in physics and of physicists in philosophy is a sign of healthy progress in science, though some hard-boiled experimental physicists have expressed the opinion that much of it is merely an excuse for talking, which ends only in futility. However this may be, and however true it may be that philosophers have asked and will probably continue to ask many questions that physicists can not answer, it is also a fact that their observations, even when irritating, serve a useful purpose if they foster a more careful examination of what physicists mean by what they say. Consider, for example, the statement that physics is a "vicious abstraction."[2] This ought to be sufficient to start a train of thought or at any rate to throw a new light on the old question: What is physics? We may take it for granted that the author of the statement is not attributing vice to physicists but is using the term "vicious" in its purely technical sense of faulty or incorrect. The statement implies, therefore, that physicists are guilty not only of abstraction but abstraction of an essentially bad kind.

It is perfectly clear to all physicists who have taken the trouble to think about the foundations of their science that physics deals with an abstraction from the totality of experience. Reading of the article just mentioned suggests that the inherent viciousness lies in the fact that physicists are willing to work with only that kind of experience which they can control with some precision in the laboratory. This they proceed to isolate from all "foreign" influences and then to describe in terms of a language that is also specifically invented for this purpose and is quite different from that of everyday speech. If they achieve a measure of success in this description, it is only, to accept the view of the philosopher critic, because they have deliberately decided to forego any relation of the abstracted experience to the rest of experience.

It is probably unnecessary to analyze these strictures in detail. Most physicists will be likely to see in them only the distaste of a philosopher for anything less than the whole universe as a realm of discourse and the well-defined fear that if any part of experience is left out of consideration, the description of the rest is bound to be inadequate. We may frankly admit that this situation has not seriously disturbed physicists in the past, but it serves once more to focus attention on the fundamental problem of what physicists really do.

The activity of the physicist naturally divides itself into two parts: (1) the acquisition of experience and (2) the description of experience. Both processes involve abstraction. In the first the physicist examines the world of experience and picks out those elements that possess interest and offer possibility of coherent description, i.e., involve consistent routines. In no sense does he pretend to explain all the mysteries of nature: he is very "choosy" in his selection of material. This often irritates the philosopher and to some extent even the ordinary citizen, who is usually subject to the delusion that physicists understand everything that goes on in nature and is often sadly disillusioned when he asks a physicist about some problem only to be told that physics has not found it profitable to consider this particular group of sense impressions. Every now and then someone gets highly excited over the inability of physicists to give a clear-cut answer to a question like this: Does hot water freeze faster than cold water? There is no need to multiply examples. We are here neglecting the fact that even if the physicist attempts an explanation of the phenomenon in question his language is commonly unintelligible to the layman. We are concerned rather with the physicist's selection of data. It therefore seems worth while to make a few observations on the element of abstraction in a physicist's choice of the experience he wishes to describe. Its importance for the problem of physical explanation is obvious,

[1] Received September 30, 1942.

[2] FRIES, H. S., *Philosophy of Science*, July 1939.

since explanation inevitably depends on the character of the experience to be described. This at once suggests the question: Would not an enlargement of the domain of physical experience lead to a valuable expansion of the concepts useful for physical description? It is an alluring field for speculation. There is general recognition of the fact that it has proved extremely difficult—some would say impossible—to describe in logically consistent fashion the phenomena we call atomic in terms of the concepts developed for the description of classical macroscopic phenomena. These concepts were, of course, constructed from the experience they attempt to organize and subsume. It has frequently been pointed out that it is at best rather unreasonable to expect them to prove convenient for the description of new experience, without modification and amplification. At any rate, the fact remains that in the attempt to salvage the older concepts for use in describing newer phenomena physicists have been forced to strange devices, such as replacing Hamiltonian functions (which have a precise meaning in the theory of classical mechanics) by differential operators which have no physical meaning at all in classical mechanics. Much of the modern debate on the methodology of physics centers around the question whether this is the most effective method of stimulating physical research and of producing the type of physical theory best suited to the organization of physical knowledge, what we may call in short the best kind of physical explanation. At the present time the question is being settled on a pragmatic basis: even if the elements of the modern theory are bizarre, they are justified by the experimental confirmation of the predictions resulting from them. Logically no more can be demanded. Actually it may be doubted whether even theoretical physicists are entirely satisfied with the situation. Certainly many teachers of physics are puzzled and bewildered.

To one who insists that for the successful development of physics we must not be content to invent new concepts solely from our imagination without regard to experience but should attempt to enlarge the actual domain of that experience, the reply may be made that this is just what is really happening all the time with the advancement of modern research. In nuclear physics, for example, an almost inexhaustible mine of new experience is being opened up. Will this not supply us with new concepts? It is true that the language of physics is being enriched by many new names and that we hear much of deuterons, neutrons, neutrinos, anti-neutrinos, and mesotrons, but it is significant that these are still names of particles, i.e., elements characteristic of classical physics based on the macroscopic phenomena of motion. Physicists are still calling on the experience of classical physics to furnish the conceptual background of the new experience of recent physical discovery. We have grown so accustomed to the traditional analysis of physical experience that it is difficult to think of a departure from it or even a generalization of it. It is conceivable, however, that a useful broadening of the realm of physical data would result from closer association between physicists and psychologists in the study of the sensations. After all, these furnish ultimately all our physical experience. It would pay to investigate them rather more carefully than has been the habit of physicists in the past. Consider here the valuable work on audition started years ago by Helmholtz and continued more recently by Harvey Fletcher and his colleagues at the Bell Telephone Laboratories; also the more recent work of Wever and Bray at Princeton and Stevens and Davis at Harvard. Intensive study of all the sense perceptions can hardly fail to suggest new ways of constructing physical concepts. One of the best auguries for the success of this cooperation of the physical and biological sciences is the increasing use of physical laboratory apparatus by psychologists and biologists. The progress of science may well be accelerated in this way even faster than by intense preoccupation with very highly specialized fields like cosmic rays or nuclear physics, simply because that out of it there may come a new attitude toward the data of physics.

We have all at some time or other been struck by the essential arbitrariness or con-

ventionality of the methods of physical measurement. Thus in the construction of most scales the spaces between the marks are chosen equal. It seems a very natural thing to do, and yet how arbitrary it really is! In thermometry, for example, it amounts to a definition of temperature as a *linear* function of the length of a bar of metal or of a thread of mercury or of the pressure of a gas, etc. The procedure passes the pragmatic test in most cases, though there are certain instances where it leads to queer results; thus in acoustics the scale of absolute acoustic intensity fails entirely to agree with the scale of observed loudness, the relation being more like a logarithmic one. It is customary to treat the absolute scale as the fundamental one and to attribute the lack of agreement to the peculiar physiological behavior of the ear. When we consider that the physical theory of sound was originally based on auditory sensations, this appears as a somewhat curious circumstance. It is left to the reader as a suggestion of: (1) the possibility of supplementing the conventional realm of physical data by a modification of measuring scales, and (2) the possibility that the suggestions of how this may be usefully accomplished may come from cooperative study in the borderline field of physics and psychology through a more searching study of sense-perceptions.

The utility of these considerations for theoretical physics may be noted in the increasing interest in the part that the *observer* plays in physical theories. Classical theory treats the data of physics as independent of the observer and considers him a creature whose mistakes in making measurements can be largely ironed out by the expedient of many repetitions of the same measurement and the liberal use of an arbitrary theory of errors. The observer plays no rôle in classical physical theory except to invent the theory. Quantum mechanics and relativity have brought him back very decidedly into the picture. It would seem only reasonable to pay more attention to his actual raw experience. As an interesting commentary on the present situation a physicist who has had a great deal to do with re-emphasizing the importance of the observer in physical theories, Niels Bohr, has been led to the enunciation of a principle of limitation of human experience in the form of the so-called complementarity concept. Bohr apparently feels that physicists will forever be forced to think in terms of our intuitive notions of space and time. This implies his conviction that all physical experience will be forced into these conventional categories. This limitation would seem to be unwarranted conservatism; certainly it involves a lack of optimism with regard to the evolution of the human organism. It would be remarkable if our descendants a thousand years from now were to consider experience wholly from the standpoint of our present knowledge and methods of gaining it. It is hard to believe that the so-called primitive intuitions of space and time on which all our physical experimentation is based have reached their final form. The human mind has proved itself again and again very adaptable in adopting new points of view. Thus there was a time when the axioms and postulates of Euclidean geometry were considered to be *a priori* synthetic judgments imposed by necessity on the mind, so that without them no logical use of the space concept in science was possible. This attitude was shown to be illusory by the development of non-Euclidean geometry. The point may be made that this is of theoretical interest only and can have no influence on physical measurements. This not only begs the question at issue but is at variance with any reasonable interpretation of the history of physics, where it has been demonstrated many times that new methods of experimentation have developed from purely theoretical suggestions. There appears to be no fundamental limitation to this process except through the adoption of a point of view which must be characterized as frankly metaphysical.

What has just been said about space concepts may equally well apply to time. The theory of relativity has showed the theoretical advantage of depriving the concept of time of any preferred status and of putting it on the same logical basis as space. The objection may be made that this will have

little effect on the way in which time enters into our actual measurements. This view is of questionable merit, for the so-called primitive notion of time may ultimately undergo considerable modification by the adoption of a new attitude toward its use in physics. In physical equations, time is only a convenient parameter for the comparison of physical systems. Thus, instead of comparing two systems directly with each other and setting up a one-to-one correspondence between them, we prefer to introduce a third system called a clock and compare each system separately with this. It is a convenient though arbitrary procedure. Possibly some day we shall recognize its arbitrariness more vividly and decide to do without it. In the meantime the public or social conception of time with which the conventional procedure is linked may and probably will undergo considerable change with the rapid increase in the speed of communication. Few will argue that the widespread use of radio is not going to alter the primitive conception of time among millions of listeners. The ultimate effect of this on the interpretation of physical data may be very great. The science of mechanics, which now considers that it has solved every problem of motion when it has expressed the coordinates of every system in terms of the arbitrary time parameter, would become a quite different discipline in which the setting up of direct relations among the coordinates of different systems would take the center of the stage.

To sum up, the nature of physical explanation will undergo considerable modification in the not very distant future, not merely through changes in the language used to describe physical experience, but also through an extension of the realm of this experience itself. At the same time, no matter how enlarged this realm may become, physics will continue to remain a "vicious abstraction" to the philosopher critics, since there is no likelihood that physicists will ever include *all* experience in their data. The age-old problem of the most suitable character of physical concepts, i.e., whether they should most appropriately be linked as closely as possible to actual experience or whether they should be constructed by the free use of the imagination independently of their relation to experience, will never be solved because it is a question of taste. Nevertheless, with the broadening of the data new concepts will evolve and the nature of the abstraction which is physics will always be in continual flux like everything else pertaining to man.

ENTOMOLOGY.—*New Australian Tingitidae (Hemiptera)*.[1]

CARL J. DRAKE
Iowa State College, Ames, Iowa.

This paper contains the descriptions of three new genera, 11 new species, and one new variety of Tingitidae from Australia. The types of the new species are in my collection.

Ulonemia concava, n. sp.

Moderately large, elongate, brown, the paranota lighter in color. Head with the three front spines short, brown, tuberclelike, the hind pair short, blunt, testaceous, appressed. Rostral channel narrow, open behind, the rostrum barely reaching to middle coxae, the laminae whitish testaceous. Antennae moderately long, moderately stout; segment I a little stouter and less than twice as long as II; III long, two and one-half times as long as IV, the latter slightly thickened. Eyes moderately large, black. Legs moderately long, brown.

Pronotum moderately convex, pitted, tricarinate, the carinae distinct, not areolated, the lateral divaricating anteriorly; calli distinct, smooth; collar raised, areolated, not produced in front, the median portion slightly raised; paranota narrow, slightly reflexed, biseriate in front, very narrow, carinalike and nonreticulated behind. Elytra distinctly constricted behind the middle; costal area narrow, uniseriate, the areolae smaller at constriction; subcostal area biseriate; discoidal area bounded by sharply elevated nervures, narrowed at base and apex, widest near middle, there six areolae deep, the outer margin nearly straight.

Length, 3.45 mm; width, 0.95 mm.

[1] Received July 29, 1942.

Holotype (male) and paratype, Cedar Creek, Queensland. The paranota and constricted elytra separate it from its congeners.

Ulonemia leai, n. sp.

Moderately long, moderately broad, brown. Head brown, with five rather short, porrect, brown spines. Antennae brown, rather long, slender; segment I stouter, much stouter and twice as long as II; III nearly three times as long as IV, the latter mostly black-fuscous, moderately thickened. Rostrum extending slightly beyond mesosternum; laminae testaceous, slightly concave within on mesosternum.

Pronotum convex above, pitted, sharply tricarinate; lateral carinae distinctly divaricating anteriorly, indistinctly areolate; hood moderately large, strongly flattened above, not produced in front, very narrow and nonreticulated at humeral angles. Elytra broadest slightly beyond middle; costal area rather narrow, uniseriate; subcostal area broader, biseriate; discoidal area sharply set off by raised nervure, narrowed at base and apex, widest at middle, there seven or eight areolae deep, the outer boundary slightly sinuate; sutural area slightly more widely reticulated posteriorly. Wings longer than abdomen, smoky in color.

Length, 3.20 mm; width, 1.10 mm.

Type (female), Corns District, collected by A. M. Lea (Hacker collection). This species is broader than *U. concava* and has a distinctly dorsally flattened hood. The character of the hood will also separate it from other members of the genus.

Ulonemia decoris, n. sp.

Very similar to *U. concava* in color and form, but with the hood larger and depressed above and much broader paranota. Paranota rather broad, strongly reflexed, nearly uniform in width and not narrowed at humeri, bi- triseriate. Hood moderately large, not projecting in front, strongly depressed. Rostrum reaching meso-metasternal suture. Pronotum, elytra, and color very similar to *concava*, including constricted costal area. Antennae moderately long, brown; segment I stouter and a little longer than II; III three times as long as IV. Spines on head short, blunt, brown. Wings longer than abdomen, brownish.

Length, 3.40 mm; width, 1.00 mm.

Type (male) and allotype (female), Mount Glorious, Queensland. Paratype, 1 specimen taken with type; 6 specimens, Maleny, Queensland, January 10, 1925; Cornbiey, South Australia, N. B. Tindale.

Malandiola semota, n. sp.

Moderately large, cinereotestaceous, with brownish areas. Head convex above, brown, the front and hind pairs of spines represented by small, testaceous tubercles, the median wanting. Eyes moderately large, black, transverse. Antenniferous tubercles thick, short, testaceous. Antennae brownish, indistinctly pilose; segment I short, slightly stouter than II; III moderately long, nearly four times as long as IV, the latter short, thickened apically, mostly dark fuscous. Rostral channel deep, narrow, open behind, the rostrum extending between middle legs.

Pronotum moderately convex, pitted, tricarinate; median carina distinct, slightly elevated on triangular process; lateral carinae distinct on triangular process, becoming obsolete on disk, wanting in front; paranota very narrow, completely reflexed, carinalike at humeral angles. Collar, areolated, similar in form to *similis* Hacker, the median portion also extending triangularly posteriorly. Elytra without costal area, subcostal area triseriate; discoidal area large, widest at middle, the outer margin sinuate.

Length, 3.10 mm; width, 1.10 mm.

Type (male) and allotype (female), Murray Bridge, South Australia, H. Hacker. Paratype, 14 specimens, taken with type; 12 specimens, Williamstown and Point Lincoln, South Australia, H. Hacker; 1 specimen, Kiata, Victoria, October 1929, F. E. Wilson. This species is distinctly larger than *M. similis* Hacker and the lateral carinae are distinctly defined behind. In *similis* the lateral carinae are more or less obsolete, and the male is usually much smaller than the female. *Simplex* Horvath is a shorter species, with shorter head and collar, and the pronotum is unicarinate.

Codotingis, n. gen.

Head short, with five spines. Eyes large. Rostral channel open behind, the rostrum long. Bucculae closed in front. Orifice present. Antennae slender, with segment I and II short; III longest, slenderest; IV fusiform, moderately

long. Pronotum convex, pitted, tricarinate, moderately narrowed anteriorly; hood scarcely projecting in front, inflated, united beneath with median carina and extending posteriorly nearly to disk; paranota narrow, almost completely reflexed, reticulated. Elytra divided into the usual areas, the discoidal area large, extending beyond the middle of elytra. Wings present.

Type of genus, *Codotingis recurva*, n. sp. This genus belongs to the subfamily Tingitinae. It may be separated from *Leptoypha* Stal, *Melandiola* Horvath, and other allied genera by the hood.

Codotingis recurva, n. sp.

Small, reddish brown, the hood and elytra lighter in color. Head reddish brown, the median spine short, tuberclelike, the front and hind pairs slender, testaceous, appressed; eyes large, reddish. Antennae moderately long, slender, yellowish brown, the apical segment black; segment I short, stouter and less than twice as long as II; III slender, testaceous, three times as long as IV. Rostrum long, extending almost to end of sulcus, the sulcus gradually widening posteriorly.

Pronotum distinctly tricarinate, the lateral carinae long, thin, divaricating a little anteriorly; median carina slightly higher than lateral; hood small, inflated, projecting posteriorly, the crest located behind; paranota very narrow, uniseriate, totally reflexed except opposite calli, there nearly vertical. Elytra broadest opposite apex of triangular process, somewhat narrowed apically, completely overlapping and jointly rounded behind when at rest; costal area narrow, recurved, the outer margin not touching subcostal area; subcostal area wider, biseriate; discoidal area widest beyond middle, there seven areolae deep, the outer margin faintly raised and strongly bowed; sutural areas more widely reticulated.

Length, 2.65 mm; width, 1.20 mm.

Type (female), Nanango District, Queensland, November 1927, taken by H. Hacker.

Callithrincus serratus Horvath

Two specimens, male and female, National Park, Queensland, May, 1934, F. A. Perkins. The male is distinctly narrower than the female. The antennae are moderately long, slender, brown, the apical half of terminal segment black, thicker and hairy; segment I short, stouter and twice the length of II; III very slender, straight, three times as long as IV. The rostral channel is deep, narrow, entirely open behind, the sides foliaceous and areolate; rostrum very long, not quite reaching the end of the sulcus. The bucculae are broad, areolate, and closed in front.

Callithrincus signatus, n. sp.

Color, shape, and general appearance very similar to *C. serratus* Horvath, but separated from it by the triseriate costal area, median carina less foliaceous on disk, and the paranota much less turned up and less elevated within. Rostrum long, extending to end of sulcus. Antennae brown, the distal half of last segment black; segment III very slender, three times as long as IV. Head with five stout, moderately long spines. Pronotum moderately convex, truncate in front, the erect protuberance at base of collar smaller than in *serratus* and the setose hairs on paranota fewer and shorter; median carina sharply arched but not strongly foliaceous on disk, moderately elevated apically. Nervure separating subcostal and discoidal areas sinuate, the erect, setose hairs mostly wanting or greatly reduced. Costal area irregularly bi- triseriate, the outer margin spined as in *serratus*. Other characters very similar to *serratus*.

Length, 2.95 mm; width, 1.25 mm.

Type (male) and allotype (female), Mount Glorious, Queensland, September 26, 1928, H. Hacker.

Inonemia, n. gen.

Head not strongly produced in front, with two hind spines; clypeus prominent, ridgelike; eyes moderately large. Antenniferous tubercles short, stout; antennae moderately long, rather slender; segment I short, a little stouter and longer than II; III longest, straight; IV moderately long, scarcely thicker than III. Bucculae very broad, reticulated, closed in front. Rostrum extending to mesosternum; rostral channel rather broad, the laminae rather low, meeting behind. Legs short, the femora short. Orifice indistinct. Pronotum moderately convex, pitted, tricarinate, the lateral carinae long, strongly divaricating anteriorly; calli present; collar raised, reticulated; hood absent, paranota expanded and reticu-

lated in front, wanting on posterial half. Elytra considerably wider than pronotum, divided into usual areas, the outer margin of costal area strongly, arcuately rounded at the base; wings present.

Type of genus, *Inonemia mussiva*, n. sp. Allied to genera *Neotingis* Drake and *Acysta* Champion but easily distinguishable by its semilacy appearance, distinctly divaricating lateral carinae, short femora and paranota. The head is also a little longer and broader; the pronotum, paranota, and elytra are very similar in texture and appearance.

Inonemia mussiva, n. sp.

Cinereotestaceous, with indistinct brownish areas. Head reddish brown; eyes reddish black; hind pair spines short, testaceous, appressed, not reaching middle of eyes. Antennae indistinctly pilose, testaceous, the tip of terminal segment black; segment II about twice as long as IV. Rostrum and laminae dark fuscous. Legs short, beset with short setae, testaceous, the femora short, rather stout, reddish brown.

Pronotum coarsely pitted, truncate in front, a little darker in color than elytra; calli impressed, dark brown; carinae distinct, not foliaceous; paranota short, projecting laterally, biseriate, not extending posteriorly beyond calli; hind triangular process large, more coarsely pitted. Elytra broad at base, about the width of costal area, wider than pronotum, widest near the basal third, thence narrowed posteriorly; costal area rather broad, mostly biseriate, the areolae not very large and nearly rounded; subcostal area long, rather narrow, triseriate in widest part; discoidal area large, extending considerably beyond middle, widest near middle, there six or seven areolae deep, the areolae small and rounded; sutural area large, areolae becoming a little larger distally.

Length, 2.30 mm; width, 1.10 mm.

Type (male) and allotype (female), Roma, Queensland, November 30, 1930, L. Franzen.

Inonemia mussiva brevis, n. var.

Very similar to *I. mussiva* n. sp. but with much shorter antennae, the entire antennae being shorter than the third antennal segment of *mussiva*. Antennae short, testaceous, the apical third or fourth black; segment I short, scarcely longer or thicker than II; III twice as long as IV. Other characters similar to *mussiva*.

Type (female), Roma, Queensland, November 30, 1930, collected by L. Franzen.

Engynoma, n. gen.

Head short, convex above, with five slender spines. Eyes moderately large, transverse. Bucculae broad, areolated, closed in front. Rostral channel rather deep, moderately wide, open behind, the laminae foliaceous. Antennae rather slender, moderately long; segments I and II short, moderately thickened; III long, slender; IV fusiform, moderately long. Pronotum convex above, moderately narrowed anteriorly, tricarinate; all carinae long; hood absent; collar distinct, areolated, with two erect spines. Calli present; paranota narrow, linear, reflexed, areolated, with or without spines on margins; hind process long, triangular. Elytra longer than the abdomen, jointly overlapping behind when at rest, with the usual areas sharply defined. Legs moderately long, slender.

Type of genus, *Engynoma* (*Perissonemia*) *tasmaniae* Drake and Poor. *Tingis spinicollis* Horvath, *T. angulata* Hacker, and *T. insularis* Hacker also belong to this new genus. In these four species and the two new forms described below, there is an erect, slender, moderately long, sharp spine on each side of the median line (near the middle) of the collar. In *spinicollis*, *angulata*, and *insularis*, the lateral margins of the paranota are also armed. In *immaculata* n. sp., *deaba* n. sp., and *tasmaniae* (Drake and Poor), the paranota are unarmed. The six known species are all rather similar in appearance and from the Australian region.

Engynoma immaculata, n. sp.

Elongate, narrow, testaceous; legs and antennae brownish, the tarsi and terminal segment of antennae black. Head pale brown, with five long, slender, testaceous spines. Rostrum brown, extending almost to middle of mesosternum, the laminae pale testaceous, not meeting behind.

Pronotum moderately convex, finely pitted, carinae distinctly more foliaceous than in *tasmaniae*, uniseriate, the areolae broader; paranota also distinctly broader, uniseriate, strongly reflexed, uniseriate behind, biseriate in front, the outer row of areolae large, broader than long, rectangular; collar rather long, finely areolated, the two spines erect, slender, rather

long. Elytra elongate, slightly constricted beyond the middle, the margins subparallel; costal area slightly reflexed, rather narrow, mostly biseriate, the inner row of areolae very small and sometimes disappearing at the constriction; subcostal area a little broader, triseriate; boundaries separating subcostal, discoidal and sutural areas distinctly raised, finely areolated. Legs slender, pale brown, the tarsi black.

Length, 3.00 mm; width, 0.80 mm.

Holotype (male), Cedar Creek, Queensland, January 25, 1931, H. Hacker. This species is more elongate and has more foliaceous carinae and paranota than *tasmaniae*. It is not easily confused with other members of the genus.

Engynoma deaba, n. sp.

Moderately large, cinereotestaceous, with a few small, black-fuscous markings. Head dark brown, shiny, with five testaceous spines, the median porrect. Rostral channel narrow, deep, the laminae testaceous, foliaceous, not meeting behind; rostrum dark brown, reaching between middle legs. Antennae testaceous, indistinctly pilose; segment I short, slightly longer and stouter than II; III about two and one-half times as long as IV, the latter fusiform and mostly black. Eyes rather large, black. Legs testaceous, the tips of tibiae and tarsi dark fuscous.

Pronotum moderately convex, pitted, tricarinate; carinae foliaceous, each uniseriate; the areolae moderately large, the lateral pair slightly diverging anteriorly, slightly concave within on disk; collar distinct, areolated, the two spines erect; paranota rather narrow, moderately reflexed, slightly wider opposite calli, uniseriate; triangular process with a transverse, black-fuscous band near the middle extending across costal and subcostal areas; boundaries separating subcostal, discoidal and sutural areas moderately elevated, finely areolated; costal area uniseriate, the areolae moderately large; subcostal area triseriate, the areolae small.

Length, 3.20 mm; width, 1.10 mm.

Holotype (female) and paratype, National Park, Queensland, December, 1933, H. Hacker. This insect is a little larger than *angulata* (Hacker), *insularis* (Hacker) and *spinicollis* (Horvath) and the lateral margins of the paranota and elytra are without spines.

Furcilliger comptus, n. sp.

Moderately large, obovate, brownish to yellowish brown, sometimes with a few small fuscous spots, armed with numerous slender spines, and rather densely clothed with fine, decumbent hairs. Head brownish, with five long, slender nearly erect, brown spines; eyes rather small, dark. Rostrum long, brownish, black at apex, extending almost to end of sulcus; laminae thick, high, finely hairy, not widely separated, entirely open behind. Bucculae broad, V-like excavated in front, meeting at the base, produced downward at each end in front so as to form a small tooth. Legs moderately long, pale brown, beset with numerous, short, bristly hairs. Antennae moderately long, brownish; segments I and II thick, beset with bristly hairs, the latter shorter and obconical; III long, slender; IV absent.

Pronotum rather strongly convex, clothed with numerous short hairs, tricarinate; lateral carinae strongly converging behind disk and then slightly converging anteriorly until they become contiguous with the sides of the median carina, terminating in front at base of hood, each finely areolated; median carina distinctly more elevated on disc, there arched; all carinae beset with slender spines; hood small, scarcely produced in front, highest near center, there with a forked spine. Paranota almost completely reflexed, beset with numerous sharp spines, the outer margin turned up so as to appear almost like lateral carinae. Triangular process rather large, hairy, areolate. Elytra clothed with fine hairs, with lateral margins and nervures separating areas beset with slender spines; costal area rather broad, with three, moderately large, confused rows of areolae, the areolae hyaline; subcostal area narrower, biseriate; discoidal area large, widest a little behind middle, the outer margin sinuate. Sides of thorax beset with fine bristly hairs. Venter brownish, with shorter bristly hairs. Wings smoky, nearly as long as elytra, the latter a little longer than abdomen.

Length, 3.90 mm; width, 1.80–2.00 mm.

Type (male), allotype (female), and 2 paratypes, Imbil, Queensland, January, 1936, collected by A. R. B. Combs, on *Gmelina leichhardtii* (family Verbenaceae). This species has differently formed paranota, carinae, and wider costal area than *T. asperulus* Horvath. It is

also clothed with hairs and armed with many more spines. There may be some question regarding the generic position of *comptus* n. sp., but it seems advisable to place it in *Furcilliger* Horvath until the limits of the genus are more clearly defined.

Leptopharsa enodata, n. sp.

Head brown, convex above, with five moderately long spines, the three frontal spines testaceous and erect, the hind pair brownish and appressed. Bucculae broad, reticulated, contiguous at the base in front, the margins in front above the base angulately excavated so as to form a V-opening. Rostral channel wide, wider and concave within on mesosternum, the laminae rather low, testaceous, reticulated; rostrum extending to middle of mesosternum. Antennae very long, slender, testaceous, the apical segment mostly black; segment I very long, nearly four times as long as II, the latter short; III very long, slenderest, four times as long as IV; IV long, slightly thickened, about equal in length to I and II taken together. Body beneath black. Legs testaceous, slender, the tarsi black. Eyes transverse, moderately large, black.

Pronotum brown, rather strongly convex, pitted, reticulated behind, tricarinate; median carina mostly uniseriate, arched on disk, there bi- or triseriate; lateral carinae uniseriate, strongly constricted behind disk; hood rather small, inflated, scarcely produced forward, the crest about the center; paranota rather narrow, mostly biseriate; the outer margin broadly rounded. Elytra widest in front of middle, somewhat narrowed apically, slightly constricted behind middle, the outer margin finely serrate; costal area rather broad, irregularly triseriate; subcostal area more closely reticulated, quadriseriate; discoidal area narrowed at base and apex, extending beyond middle of elytra, widest beyond middle, there six areolae deep, the outer boundary sinuate. General color of reticulation brownish, somewhat variegated with dark brown or fuscous areas. Areolae largely hyaline.

Length, 3.20 mm; width, 1.30 mm.

Type (male), allotype (female), and 1 paratype, North Pine River, Queensland, September 15, 1920, H. Hacker; 1 paratype, Conodale, Queensland, January 7, 1930, H. Hacker. This species is much slenderer than *gracilis* (Hacker) and has much narrower paranota, narrower costal area, and less foliaceous median carina. The reticulations are also a little thicker.

ICHTHYOLOGY.—*Seven new American fishes.*[1] ISAAC GINSBURG, Fish and Wildlife Service. (Communicated by ELMER HIGGINS.)

This paper originated in and is part of the result of a study of material received from two sources: (1) Some species collected by the research vessel *Atlantis* in 1937 and kindly submitted to me for study by Dr. Albert E. Parr when he was director of the Bingham Oceanographic Foundation; (2) a part of the collection of fishes obtained by the research boat *Pelican* in connection with the shrimp investigation of the Fish and Wildlife Service, which came into my hands through the courtesy of my colleagues in the service, Milton J. Lindner and William W. Anderson. Three undescribed species from the northern part of the Gulf of Mexico were found in those two collections. In attempting to distinguish properly *Emblemaria piratula* and determine its affinities, I discovered three undescribed species of that genus in the National Museum, and mixed in with the Emblemarias one new goby. All these species are described herein. Two of the species are described from specimens obtained by the well-known Wilkes Expedition more than a hundred years ago. All the holotypes are in the U. S. National Museum. Paratypes of two species are deposited in the Bingham Collection.

Bollmannia communis, n. sp. (Gobiidae)

Soft dorsal and anal predominantly with 14 rays, sometimes 13 or 15. (Out of 78 specimens in which the rays were counted in both fins, 64 have the predominant counts; 2 have 13 rays in both fins; the other 12 variants have only either fin with 13 or 15 rays while the other has 14.) Pectoral rays 21–23, the tip of

[1] Received July 18, 1942.

the fin reaching a vertical variably placed between the bases of the first to third dorsal ray. Approximately upper third of opercle almost entirely covered with two large scales. Cheek well scaled from about middle of eye backward, except a rather broad naked strip along its lower margin. Fourth or fifth spine the longest, tip of longest spine usually reaching, when stretched along the back, to base of fourth ray of second dorsal in large male, varying from base of third to seventh; to base of first or second ray in female. Posterior dorsal and anal rays of male reaching more or less beyond end of hypural, those of female about reaching there or slightly short. Tip of ventral fin about reaching anus, often slightly past anus in male or slightly short in female. As compared with all 11 species of *Bollmannia* now authentically known, the caudal is rather long, longer or as long as in most of them, but averaging shorter than in *longipinnis;* the head averages moderately long and the eye is medium to rather large. First dorsal with a posterior black spot; male with a broad, black or dusky band on the distal margin of the same fin · other fins shaded more or less with dusky or blackish; head and body usually without definite marking, body sometimes with a median row of five faint smudges.

This species is described from 81 specimens, 45–108 mm, obtained in the northern part of the Gulf of Mexico; 37 specimens obtained by the *Atlantis* in 1937 at 5 stations; 44 specimens obtained by the *Pelican* during 1938–39 at 16 stations. The extremes of the geographic range of the samples studied are from off Padre Island, Tex., to off the Mississippi Delta; between latitudes 26° 34′ and 29° 29′ and longitudes 88° 46′ and 96° 53′ 30″. The extremes of the vertical range are 3.5 to 45 fathoms. This is evidently a common species in that region, and it is remarkable that it has remained undiscovered up till now. It is not that it has been masquerading under an alias. As far as I know, no specimens have ever been recorded under any name. It probably has a circumscribed geographic or vertical distribution.

Holotype, U.S.N.M. no. 119873: *Pelican* station 77-1; 28° 59′ N., 89° 29′ W.; 10 fathoms; male, total length 83 mm, standard length 52.5 mm; caudal 59, ventral 30.5, pectoral 26.5 depth 25, peduncle 12.5, head 29, postorbital, 13.5, head depth 20.5, head width 17, maxillary 13.5, snout 9, eye 8.5, antedorsal 34.

This species is structurally nearest to *Bollmania* (sic) *litura* Ginsburg (Smithsonian Misc. Coll. **91** (20). 1935), from the coast of Haiti. It has the eye not so large as in *litura* (which has a very large eye, larger than in any known species of its genus); there are no intergrades in this measurement among specimens of the two species so far measured. The second dorsal and anal counts are distinctly higher in *communis,* although there is some slight degree of intergradation. The head and postorbital average less in *communis;* but there is considerable intergradation in those measurements.

Another congener that occupies adjacent waters, *B. boqueronensis* Evermann and Marsh, differs from *communis* in having a lengthwise row of scales along the lower margin of the cheek; a shorter head, there being no intergrades in the specimens measured; and fewer dorsal and anal rays but with a slight degree of intergradation.

Recently Fowler described what he took to be a new species, *Bollmannia jeannae* (Proc. Acad. Nat. Sci. Philadelphia **93**: 95, figs. 7–9. 1941) from off Key West. I have not examined Fowler's specimens, but judged by his description and figure it is evident that they do not belong to the same species as *communis. B. jeannae* is probably based on specimens of *Bollmannia boqueronensis;* anyway his description and figure do not prove that they differ from it. Fowler does compare his *jeannae* with *boqueronensis* and points out certain differences, but they do not hold. The same differences are apparent also when authentic specimens of *boqueronensis* are compared with the figure published by Evermann and Marsh. This is because that figure is not altogether accurate. But the supposed differences are seen to be nonexistent when correctly identified specimens of *boqueronensis* are studied.

Garmannia mediocricula, n. sp. (Gobiidae)

Garmannia hemigymna Fowler (not Eigenmann and Eigenmann), Proc. Amer. Philos. Soc. **82**: 791. 1940 (Rio de Janeiro).

D. VII; 12–13. A. 10. P. 20–21.

Anterior scales, from near base of pectoral to under space between the two dorsals, in a

very narrow band of one row and a second incomplete row; thence scaled area broadening out in wedge-shaped manner to ends of vertical fins; caudal peduncle completely scaled. About 34 scales in a complete longitudinal row. (Most scales in caudal row missing; but judged by traces of their impressions there were probably 4.) First spine in male shorter than second. Head subterete. Maxillary in male ending approximately under posterior margin of pupil. (The two specimens are now uniformly dark; possibly any color pattern originally present has faded by now.)

Ventral 24.5, pectoral 24–24.5, depth 20.5, peduncle 14.5, head 30.5–31, postorbital 18.5–19, head depth 16–17, head width 17, maxillary 13.5, snout 7.5–8.5, eye 8.5–9.5, antedorsal 38.

This species is described from two specimens, 28–29 mm as now measured, the caudals frayed at the end, 23–23.8 in standard length; obtained by the Wilkes Expedition at Rio de Janeiro. The smaller specimen is designated the holotype, U.S.N.M. no. 119876.

The extent of squamation of this species is rather intermediate between *G. hildebrandi* and *G. paradoxa*, from the Atlantic and Pacific coasts of Panama, respectively; but as shown by the lateral line organs *mediocricula* is nearer structurally to the Pacific *paradoxa*. Besides some differences in the details of the lateral line organs, *mediocricula* differs from *paradoxa* in having a subterete, instead of depressed, head, more pectoral rays and a more extensive squamation. Of its Atlantic coast congeners, *mediocricula* is probably nearest to *G. spes;* but no specimen of *spes* of adequate size is availab'e for comparison. It differs widely from *spes* in the number of pectoral rays.

While I have so far not examined the type of *Gobius hemigymnus* Eigenmann and Eigenmann, their description differs so widely and in so many important particulars from the two specimens here described that they cannot belong to that species as they were identified by Fowler. *"Gobius" hemigymnus* is probably a species of *Risor*.

Lonchopisthus lindneri, n. sp.
(Opisthognathidae)

D. X–XI 18. A. III 16–17. P. 18–19. Caudal with 16 segmented rays.

Gill rakers 18–22 on upper limb of first gill arch, 33–36 on lower limb; total number of gill rakers on first arch 51–55 (range of both sides of the three specimens studied). Scales in 59–60 oblique rows below lateral line and 25 rows behind lateral line, to base of caudal; 37–39 scales in lateral line, ending under base of sixth soft ray. Scales present on antedorsal area to a vertical at a little dis'ance behind posterior margin of eye; present also on throat in front of ventral base, and on pectoral base; cheek nearly all scaled behind a vertical through posterior margin of eye; a patch of scales on upper anterior part of the opercle in three or four lengthwise rows and extending over about anterior half of opercle; the narrow space between lateral line and base of dorsal with a lengthwise row of embedded, sometimes partly with nonimbricate scales, the row sometimes partly interrupted. Maxillary ending on a vertical behind eye, at a distance a little less than diameter of pupil, its posterior edge well emarginate, with a large supplemental bone. Second soft ventral ray, from its outer margin, notably prolonged, reaching past origin of anal. Posterior edge of pectoral on a vertical approximately through base of tenth dorsal spine. Soft rays of dorsal and anal unbranched, except last three or four branched, the last one divided to its base. Teeth in a single row in each jaw, of moderate size, none notably enlarged; no teeth on vomer.

Head and body uniformly colored in one specimen, anterior part of body with a few very faint, light, narrow, diffuse cross bands against a darker background in two; vertical fins dusky, caudal darkest becoming black posteriorly; outer surface of lower lip with a black area at angle of mouth, wedge-shaped, tapering anteriorly towards upper margin of lip, extending about midway between angle of mouth and symphysis of jaw, sharply marked in two specimens, rather faint in one.

Measurements of two specimens 96–105 mm, 60.1–61.7 mm in standard length. Caudal 59–70.5, pectoral 23–24, depth 26.5–29, peduncle 9–9.5, total length of head 30.5–32.5, length of head to tip of opercular spine 27.5–30, total length of postorbital 16–18.5, head depth 23–23.5, head width 14–15.5, maxillary 17.5–18.5, snout 5–6, eye 10–11, antedorsal 31.5–32.5.

This species is described from three specimens: *Pelican* station 112-4; off Padre Island, Tex.; 27° 13′ N., 96° 47′ W.; 33 fathoms; 64

mm in standard length with a teratological jaw on one side and generally in poor condition. *Atlantis* station 2840; off Isle Derniere, La.; 28° 19′ N., 90° 59′ W.; 31 fathoms; 61.7 mm in standard length. *Pelican* station 112-3; off Padre Island; 27° 13.5′ N., 96° 40′ W.; 42 fathoms; 60.1 mm in standard length. The species thus inhabits the same region, at the same depth, as *Bollmannia communis*. The latter two specimens were taken together with that species. The last specimen is designated as the holotype, U.S.N.M. no. 119874. The specimen obtained by the *Atlantis* is deposited in the Bingham Collection.

This species is nearest to *L. micrognathus*, a short account of which is given below for the purpose of comparison. It differs chiefly in having fewer gill rakers on the first gill arch. The cross-banded color pattern, judged by current descriptions of *micrognathus*, is apparently less distinct in *lindneri*. Judged by the specimens examined, it appears that *lindneri* may differ in the frequency distributions of some characters, namely, in averaging a lower scale count, a higher soft dorsal and pectoral count, a longer head, maxillary and antedorsal distance, and a larger eye, possibly also a longer caudal; but these can be determined only from much larger samples than those available. It may be of some significance that one of the three specimens of *lindneri* has 10 dorsal spines, whereas *micrognathus* appears to have constantly 11. This species is named for Milton J. Lindner, of the Fish and Wildlife Service.

Lonchopisthus micrognathus (Poey)

D. XI 17–18. A. III 16–17. P. 18.

The above counts are based on three specimens from Cuba which I had for comparison with the preceding species: Poey's two types (U.S.N.M. no. 4785), 59–76 mm in standard length, now in bad condition; a small specimen 24 mm in standard length (no. 82510). Gill rakers in the two larger specimens 22–24 on upper limb of first gill arch, 39–40 on lower limb, total count 62–63 (range of one side of each). Oblique rows of scales below lateral line about 62–74. Caudal broken in the larger specimen, probably entire or nearly so in the two smaller, 44.5–50.5. In the two larger specimens: head to tip of opercular spine 26–27.5, maxillary 16–17, eye 9–9.5, antedorsal 28.5–29.5. Longley (Carnegie Inst. Washington Publ. **535**: 244. 1941) states that all his Tortugas specimens of this species had 11 dorsal spines, the same count as determined by me.

Emblemaria signifer, n. sp. (Blenniidae)

Emblemaria atlantica Fowler (not Jordan and Evermann), Proc. Amer. Philos. Soc. **82**: 796. 1940 (Rio de Janeiro).

D. XX 12. A. II 20–21. P. 13.

First dorsal spine notably longer than following spines, in form of long filament, its tip reaching, when stretched along back, to base of tenth dorsal spine; second spine less than half length of the first; third spine subequal to second; fourth appreciably longer than preceding two; gradually increasing in length from fourth to eighth; eighth to eleventh subequal; thence gradually decreasing; last spine notably short, about half of first segmented ray; distal edge of dorsal thus with two well marked depressions, one behind first spine, the other between the two parts of the fin. Orbital cirrus very short, less than diameter of pupil, rather broad, unbranched, without fimbriae; narial cirrus slenderer and slightly longer. Maxillary reaching a vertical behind eye at a distance slightly over half its diameter in the larger specimen, not quite as far in smaller. Ventral apparently falling considerably short of anus (broken near its end). A few dark spots near base of dorsal distantly placed from one another, not alined in a regular row; anterior part of dorsal black basally, with a whitish margin; color evidently faded now and no other marks discernible.

Measurements of holotype, U.S.N.M. no. 119877, Rio de Janeiro, Wilkes Expedition: Total length 33 mm, standard length 27.8 mm, caudal 19.5, depth 18.5, peduncle 9, head 25.5, postorbital 15.5, maxillary 14.5, snout 7, eye 7, antedorsal 19.5. This account is drawn from the holotype and one paratype, 27 mm (U.S.N.M. no. 83144), the two specimens originally in the same lot.

The specimens here described do not belong to *E. atlantica* as they were identified by Fowler, but to a hitherto undescribed species. In fact, *signifer* is one of the more strongly marked species of its genus. The soft dorsal count is lower than in any species of *Emblemaria* so far discovered; the spinous dorsal and

anal counts are lower than in most of them; the outline of the dorsal, especially the filamentous and very long first spine as compared with the following spines is different than in any of them. (The dorsal outline of *guttata*, the next species described, comes nearest to that of *signifer*, but the difference is still considerable.) The latter character may possibly differ with age and sex. That remains to be determined. But it is very unlikely that such sex or age differences, if any, will be sufficiently pronounced to mask species differences. The combination of the above characters, together with the very short orbital cirrus, should make the identification of specimens of *signifer* an easy matter.

Emblemaria guttata, n. sp.

D. XXII 14. A. II 23. P. 14.

First dorsal spine moderately longer than second, its tip reaching base of ninth dorsal spine; the spines gradually increasing in length from second to fourth, thence decreasing; last spine considerably shorter than first segmented ray; the distal dorsal edge thus with two moderate emarginations, one behind first spine and one between the two parts of the fin. Orbital cirrus slender, medium, somewhat less than eye diameter, branched at base; narial cirrus still shorter, likewise branched. Maxillary reaching a vertical past eye at a distance about equaling half its diameter. Ventral ending at a considerable distance before anus.

An area on upper half of fish, under anterior part of dorsal, comprising posterior part of head and anterior part of body, irregularly beset with small dark spots; a median row of somewhat larger spots on body from base of pectoral backward, well marked on anterior part of body, faint or hardly perceptible on posterior part; anterior part of dorsal, between third and seventh spines and centered along middle of fin, with a large very dark brown spot, elongate-elliptical with its long axis in a lengthwise direction, rather well marked off from surrounding pigment; basal area of fin below spot very light, distal area and that behind spot dark, but appreciably lighter than spot.

Holotype, U.S.N.M. no. 101999; Secas Isle, Panama; 12 fathoms; W. L. Schmitt; February 5, 1935. Its measurements are as follows: Total length 36 mm, standard length 30.7 mm; caudal 18, peduncle 9, head 29.5, postorbital 16.5, maxillary 16.5, snout 6.5, eye 9, antedorsal 20.

This species about agrees with *E. nivipes* Jordan and Gilbert, another species from Panama, in the number of dorsal and anal rays and in having a rather small, ramose orbital cirrus; it differs in the outline of the dorsal and in color. The dorsal outline of *guttata* resembles that of *signifer* described above from the Atlantic, but the two depressions in the fin are rather shallow, not so pronounced as in the latter. The rather profuse and fine spotting on part of the head and body is unlike the species of *Emblemaria* so far discovered, most of which have a diffuse and rather faint cross-banded color pattern.

Emblemaria piratula Ginsburg and Reid, n. sp.[3]

Suborbital very rough and bony at the surface, irregularly rugose and pitted, its distal margin somewhat roughly and irregularly crenate; anterior upper quadrant of orbital rim likewise bony and irregularly, rather rudimentarily tuberculate, but without definite, well-marked tubercles; two parallel ridges on upper aspect of snout presenting somewhat same appearance as orbital rim. Dorsal modally with 19 spines (in 9 specimens), sometimes with 18 (in 1) or 20 (in 2); segmented rays usually 14 (in 6) or 15 (in 5), sometimes 13 (in 1); total dorsal count 33 (in 7) or 34 (in 5). Anal with 2 flexible spines, modally with 21 segmented rays (in 8), often with 20 (in 4). Pectoral rays typically 13 (in 9), sometimes 12 (in 1). Anterior part of dorsal high, the spines increasing in length from first to fourth or fifth; tip of fourth spine about reaching base of twelfth to fifteenth; fourth to sixth spines highest, subequal; thence decrease gradually in length; last spine subequal to first segmented ray, the two parts of the fin nearly altogether and smoothly continuous. Orbital cirrus well developed, rather stout, long, nearly reaching to dorsal origin or a little short (broken off in most specimens); simple narial cirrus less than eye

[3] After I had drawn up a preliminary account of this species based on the *Pelican* specimen, I went to compare it with material of its genus in the National Museum and found that Earl D. Reid had independently come to the conclusion that the *Albatross* specimens represented an undescribed species. We therefore agreed to publish this species jointly.—I. G.

diameter. Maxillary reaching a vertical past eye at a distance about equalling diameter of pupil or not quite that far. Tip of ventral reaching anus or falling moderately short. Posterior margin of pectoral approximately on a vertical through anal origin.

Color of comparatively recently preserved specimen: Anterior part of dorsal black with a subtriangular whitish area near base, the black color gradually fading out posteriorly; head and body dusky, nearly uniformly sprinkled with minute, nearly microscopic, dark dots, except light, pigmentless areas on upper posterior part of head, upper, anterior part of body, and along dorsal base; no other distinctive markings. The specimens collected in 1885 have the color of the dorsal as described above, except that in some of them the black pigment is absent near the base of the fin; the head and body have now faded.

Measurements of one paratype: Total length 25 mm, standard length 21.4 mm; caudal 18, depth 17.5, peduncle 8.5, head 28, maxillary 14, snout 6.5, eye 6.5.

Holotype: U.S.N.M. no. 119875; *Pelican* Station 142-6; off St. Andrews Bay, Fla.; 29° 56′ N., 86° 7.5′ W.; 18 fathoms; 22 mm. In addition, the National Museum has 11 specimens, 22–27 mm, obtained by the *Albatross* in 1885 at three stations off the west coast of Florida, in 24–26 fathoms, as follows: Station 2406, 28° 46′ N., 84° 49′ W., 26 fathoms (U.S.N.M. no. 101091); station 2407, 28° 47′ 30″ N., 84° 37′ W., 24 fathoms (no. 101090); station 2374, 29° 11′ 30″ N., 85° 29′ W., 26 fathoms (no. 101089). The above account of the species is drawn from these 11 paratypes and the holotype. One specimen, 20 mm, in no. 101091 is in bad condition, and its identification not altogether certain.

This is a well-marked species. The black anterior dorsal with its well-marked white spot at the base is very distinctive and imaginatively suggests the pirate's flag. The spinous dorsal and the anal counts average lower than in all species of *Emblemaria*, except *signifer*. The rough, bony suborbital gives it a distinctive appearance. In other species of *Emblemaria* the suborbital is also rough after the skin is removed; but in *piratula* it is so at the surface, and more decidedly so. This as well as the strong ridges on the snout apparently represent the initial stages in the development of the head armature as seen in the related genus *Acanthemblemaria*.

Emblemaria piratica, n. sp.

D. XXI 13. A. II 24. P. 13.

Upper aspect of snout with two lengthwise parallel rows of bony tubercles, one on each side of and near to midline, four tubercles in a row, one similar tubercle on midline between the two rows, near their posterior end; upper anterior quadrant of orbital rim roughly tuberculate, but not with the rather clear-cut tubercles of snout; one tubercle slightly behind and below nostril; suborbital not bony nor rough at surface. First three spines very high, subequal, tip of third reaching to base of sixteenth dorsal spine; fourth to sixth spines considerably shorter than first three, and moderately shorter than following spines, the margin of the dorsal therefore forming a moderate depression behind anterior three spines; the spines from seventh backward gradually decreasing in length; the last spine but little shorter than first segmented ray, the two parts of the fin thus nearly continuous, forming one fin with but a slight depression between them. Orbital cirrus about half diameter of eye, very slender, not branched; narial cirrus similar, somewhat shorter. Maxillary reaching a vertical past eye, at a distance a little less than diameter of pupil. Tip of ventral falling only a little short of anus.

Head and body a nearly uniform reddish brown; body with rather faint spots in a median row, the anterior ones very faint, the posterior ones somewhat better marked. The anterior and highest part of dorsal black; the more posterior part of spinous dorsal, from fifth spine backward, traversed by broad, oblique bands, running obliquely downward and backward, alternating black or dusky and light yellowish pigmentless; the soft dorsal dusky basally and distally, light and pigmentless along its middle part, lengthwise; anal with a broad blackish marginal area, more intensely pigmented anteriorly than posteriorly, the basal part of fin dusky; ventral dark, nearly black; pectoral and caudal light.

Holotype and only specimen studied: U.S.N.M. no. 101944; Secas Isle, Panama, 12 fathoms; W. L. Schmitt; February 5, 1935. Total length 28 mm, standard length 23.8 mm; caudal 18.5, depth 18.5, peduncle 7.5, head 28,

postorbital 16.5, maxillary 12.5, snout 6.5, eye 8.5, antedorsal 19.

The presence of distinct rather well developed bony tubercles on the upper aspect of the snout sets off *piratica* from all its congeners now known. The other species of *Emblemaria* have bony ridges in the same location. In *piratica* these ridges have developed distinct tubercles. As noted under *piratula*, here also this character evidently represents one of the first stages in the development of the armature of the head, which reaches a high degree in *Acanthemblemaria*.

ZOOLOGY.—*Further remarks on some Mexican* Urosaurus.[1]

M. B. MITTLEMAN.
(Communicated by HERBERT FRIEDMANN.)

A short time ago I had occasion to discuss *Uta nelsoni* Schmidt in a review of the Mexican so-called *Uta ornata* complex. I indicated at the time (This JOURNAL **31**: 72–73. 1941) that on the basis of the type alone this nominal form seemed distinct enough from *bicarinata* and *anonymorpha* but was probably best disposed of as a subspecies of *bicarinata*. More recently (Bull. Mus. Comp. Zool. **91**: 168. 1942), because no additional material had come to hand, I reiterated my former statement but included *nelsoni* as well as *bicarinatus* and *anonymorphus* in the redefined genus *Urosaurus*. As matters stood, *U. b. bicarinatus* was thought to range not farther east than Acapulco, Guerrero; *U. b. anonymorphus* was known to occur from Tierra Colorada, Guerrero to Tonolá, Chiapas; the unique type of *U. b. nelsoni* was known from Cuicatlán, Oaxaca.

Through the kindness of Dr. Edward H. Taylor I have had opportunity to examine, and report herewith, four *Urosaurus* from the type locality of *nelsoni* (EHT-HMS nos. 14054–57); in addition, Dr. Taylor has kindly lent me three *Urosaurus* from Totolapan, Oaxaca, which is about midway between Cuicatlán and the previously known range of *anonymorphus*. The seven specimens are exceedingly interesting, clarifying as they do the status of *nelsoni* and offering further information on the relationships and distribution of *bicarinatus* and *anonymorphus*. The apparent differences, which I previously reported as existing between *nelsoni* and the more southerly races *bicarinatus* and *anonymorphus*, now appear to rest solely on the basis of individual variation in the type specimen of *nelsoni* (U.S.N.M. no. 46836). With good series of *anonymorphus* and *bicarinatus* before me, as well as Dr. Taylor's topotypes of *nelsoni*, I fail to note anything of a distinctive nature in the *nelsoni* that would serve to separate them from *bicarinatus*. The characters I heretofore considered diagnostic of *nelsoni*, as the immucronate ventrals, poor development of dorsolateral and lateral tubercles, smaller enlarged dorsals, and different proportions of the head, lack confirmation in these newly available individuals. In all the characters named, as well as others, I can not distinguish between *nelsoni* and *bicarinatus*. The Cuicatlán material (*nelsoni*) is fully as tuberculate, ventrals as mucronate, enlarged dorsals as big, and the head proportions are entirely within the range of variation exhibited by a good series of specimens from Cuernavaca, Morelos (*bicarinatus*). I must therefore regard *nelsoni* as a synonym of *bicarinatus*. The illusory distinction of the type specimen reflects a common type of individual or local variation seen in all Urosauri, especially in remote or end populations.

The specimens from Totolapan, Oaxaca (EHT-HMS nos. 14051–53), are interesting variants of the *anonymorphus* type; superficially they are somewhat like intergrades between this latter race and *bicarinatus*, although immediately recognizable as being much closer to *anonymorphus*. I think that here we are dealing with another case of the recrudescence of parental characters, in relatively remote populations of a derivative form, which occurs elsewhere in the Urosauri (cf. *U. clarionensis* and *U.*

[1] Received October 10, 1942.

auriculatus). Actual intergradation between *bicarinatus* and *anonymorphus* takes place, so far as known, only in eastern Guerrero, in the vicinity of Acapulco. The race *bicarinatus* largely follows the Río Balsas drainage in both the Upper and Lower Balsan biotic provinces (see Smith, Field Mus. Nat. Hist. Zool. Ser. **26**: 15 *et seq.* 1939), while *anonymorphus* is largely restricted to the Tehuantepecan province, but extends westward to eastern Guerrero (Lower Balsan) and eastward to Chiapas (Tapachulan province). Thus, as now known, *bicarinatus* extends northward from Guerrero to Puebla, thence southeastward through northern Oaxaca to Cuicatlán. *U. b. anonymorphus* ranges from Tierra Colorada, Guerrero, to Tonolá, Chiapas; the most northerly record for the race is from Totolapan, Oaxaca. In Oaxaca, the ranges of *bicarinatus* and *anonymorphus* do not meet, for the Río Balsas basin in the north and the Tehuantepec drainage of the south are separated by two great barriers: the high plains surrounding Oaxaca City and the range of mountains north of this city. The subspecies *anonymorphus* is now known from the following Oaxaca localities: Tehuantepec (type locality); Tuchitan; San Geronimo Ixtepec; Tres Cruces; Mount Guengola; Portillo los Nanches; San Bartolo; El Limón; Cajon de Piedra; Cerro Arenal; Mixtequilla; Salina Cruz; Huamelula; Totolapan. It is known also from Tierra Colorada, Guerrero, and Tonolá, Chiapas.

I am grateful to Dr. Edward H. Taylor for the opportunity to examine and publish information on lizards in his collection. Dr. Hobart M. Smith has kindly offered additional information on the Mexican biotic provinces involved.

PROCEEDINGS OF THE ACADEMY

NEW MEMBERS

The following persons were recently elected nonresident members of the Academy:

Brother LEON (JOSEPH SYLVESTRE SAUGET Y BARBIER), professor of botany, Colegio de la Salle, Vedado, Havana, Cuba, in recognition of his contributions to botany, particularly his researches on the palms of Cuba.

JOSÉ ANTONIO BERNABE NOLLA, director of Insular Government Agricultural Experiment Station, Rio Piedras, Puerto Rico, in recognition of his outstanding work in agricultural science, especially in plant physiology with tobacco and in plant nutrition from the standpoint of Liebig's law of the minimum.

313TH MEETING OF THE ACADEMY

The 313th meeting of the Academy was held jointly with the Washington Branch of the Society of American Bacteriologists, in the assembly hall of the Cosmos Club at 8:15 P.M. on October 15, 1942, with President CURTIS presiding. A. B. CRAWFORD introduced the speaker.

STUART MUDD, professor of bacteriology in the School of Medicine at the University of Pennsylvania, Philadelphia, Pa., delivered an address entitled *Structural differentiation within bacterial cell as shown by the electron microscope.* Professor MUDD discussed the differentiation of bacterial capsule, protoplasmic membrane, and nuclear material, and pointed out certain implications regarding the rationale of the uses of vaccines and serums. The lecture was illustrated with many electron micrographs.

There were about 175 persons present. A social hour followed the meeting.

377TH MEETING OF THE BOARD OF MANAGERS

The 377th meeting of the Board of Managers was held in the library of the Cosmos Club on October 19, 1942. The meeting was called to order at 8:00 P.M. by President CURTIS, with 21 persons present, as follows: H. L. CURTIS, F. D. ROSSINI, N. R. SMITH, W. W. DIEHL, J. E. GRAF, F. G. BRICKWEDDE, H. B. COLLINS, JR., W. G. BROMBACHER, E. P. WALKER, A. H. CLARK, ALEXANDER WETMORE, J. B. REESIDE, JR., J. E. MCMURTREY, JR., W. A. DAYTON, F. B. SILSBEE, E. W. PRICE, L. W. PARR, C. L. GARNER, H. G. DORSEY, HERMAN STABLER, and, by invitation, J. R. SWALLEN.

The minutes of the 376th meeting were read and approved.

President announced the following appointments: A. J. LOTKA, to be the Academy's delegate at the inauguration on September 30, 1942, of Henry Noble Wright as president of the City College of the College of the City of New York; ATHERTON SEIDELL, to be chairman of the Committee on Meetings, in place of J. H. KEMPTON, who resigned because of his appointment to an assignment in South America.

The Board authorized an additional allotment of $15 for the Committee on Meetings for

1942, with instructions to omit refreshments from the programs of the meetings for November, December, and January.

The Board instructed the President to appoint a Committee to consider recommendations regarding ways of increasing the income of the Academy.

The Secretary reported the following information regarding the membership: Acceptances to membership, 14; qualifications for membership, 18; deaths, 4; retirements, 4; resignations, 2; status of membership as of October 17, 1942:

	Regular	*Retired*	*Honorary*	*Patrons*	*Total*
Resident	437	33	3	0	473
Nonresident	137	19	16	2	174
Total	574	52	19	2	647

On recommendation of the Editors, the Board authorized the Editors to comply with the War Production Board's Order No. 977 regarding the turning in of all obsolete cuts for scrap metal (obsolete cuts being defined as all those for which request by the authors has not been made within 30 days after publication), and to charge authors for illustrations in excess of the equivalent in cost of one full-page line cut and for all unusual costs relating to foreign, mathematical, and tabular matter.

The Secretary read to the Board some proposed changes in the Standing Rules, and was instructed to distribute copies of the proposed changes to the members of the Board for action at the next meeting.

The meeting adjourned at 9:31 P.M.

FREDERICK D. ROSSINI, *Secretary.*

Obituary

WILLIAM EDWARD PARKER, Captain (Retired), United States Coast and Geodetic Survey, died on September 30, 1942, at his home in Fort Lauderdale, Fla., following a long illness. He was born at Newton, Mass. on March 21, 1876, son of William C. Parker and Emily A. (Goodwin) Parker. After graduation from the Newton High School, he entered Massachusetts Institute of Technology from which he graduated in 1899 with the degree of B.S. in Civil Engineering. He entered the field corps of the Coast and Geodetic Survey on February 18, 1901.

His first assignment in this Service was on the old *Hydrographer* in 1901 on the Atlantic coast. From 1902 to 1905 he had served on the ships *Patterson*, *Gedney*, and *Bache* on assignments in Alaska, Puerto Rico, Panama, Florida, and off the New England coast. In 1906 he went to the Philippine Islands where he served on the ship *Fathomer* for two years. After his tour of duty in the Philippines he again was assigned to duty in Alaska from 1909 to 1910 on the ship *Patterson*. From 1911 to 1914 he was engaged on coast pilot work and during the latter part of this period prepared plans for the construction of the ship *Surveyor*. He was assigned to Washington headquarters as chief of the Section of Vessels and Equipment from 1915 to 1918. In the World War he was transferred by executive order to the Navy, and from 1918 to 1919 served in the Compass Division of the Naval Observatory.

After his return to the Coast and Geodetic Survey in 1919 after the war, Captain Parker performed his most outstanding work as chief of the Division of Hydrography and Topography (now Coastal Surveys), a major division of the Service. This division has direct charge of the ships of the Service and of all coastal surveys for chart construction. He served as chief for 12 years, 1919 to 1931. It was during this period that marked improvements and developments were made in the technique and methods of hydrographic surveying. Captain Parker recognized the possibilities of echo sounding, which was developed about this time, in hydrographic surveying, and cooperated to the fullest extent with manufacturers of echo-sounding equipment. He arranged for the installation of one of the early fathometers on a Coast and Geodetic Survey ship on the Atlantic coast and encouraged the development and improvements in echo-sounding apparatus until finally the entire fleet of survey ships was fully equipped.

Following this outstanding contribution to surveying, Captain Parker next became interested in a method for locating a surveying ship when out of sight of land, now known as radio acoustic ranging. By this method the ship is located by determining the elapsed time of transmission through the water to distant hydrophones of the sound from the explosion of a depth bomb at the ship. Using this method, he planned the survey of the entire area of George's Bank in 1930 and carried this survey to a successful conclusion in 1931. While these methods naturally have now been improved and large areas surveyed since these early developments, they were the foundation of the present surveying technique of the Coast and Geodetic Survey, and have contributed in large part to the outstanding position of this Service among surveying organizations of the world.

From April 1931 to the time of retirement from active service October 31, 1934, Captain Parker was in command of the ship *Hydrographer* (new), engaged on offshore surveys in the Gulf of Mexico.

G. T. RUDE.

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